CERTIFICATION OF TRANSLATION

I, ***Eun-kyo Si***, an employee of Y.P. LEE, MOCK & PARTNERS of Koryo Building, 1575-1 Seocho-dong, Seocho-gu, Seoul, Republic of Korea 137-875, hereby declare under penalty of perjury that I understand the Korean language and the English language; that I am fully capable of translating from Korean to English and vice versa; and that, to the best of my knowledge and belief, the statement in the English language in the attached translation of ***Korean Patent Application No. 10-2003-0026004*** consisting of 24 pages, have the same meanings as the statements in the Korean language in the original document, a copy of which I have examined.

Signed this 9th day of May 2007

Eun-kyo Si

ABSTRACT

[Abstract of the Disclosure]

A flat panel display lowering an on-current of a driving thin film transistor (TFT) and maintaining excellent switching properties of a switching TFT in a manner that same driving voltages are applied thereto without changing sizes of active layers of the TFTs, satisfying uniform brightness, and maintaining a life span of a light emitting device is provided. The flat panel display includes a light emitting device, a switching thin film transistor including a semiconductor active layer having at least a channel area for transferring a data signal to the light emitting device, and a driving thin film transistor including a semiconductor active layer having at least a channel area for driving the light emitting device so that a predetermined current flows through the light emitting device according to the data signal, the channel area of the thin film transistor requiring larger current mobility than the other between the switching thin film transistor and the driving thin film transistor being thinner than the channel area of the other thin film transistor.

[Representative Drawing]

FIG. 3

SPECIFICATION

[Title of the Invention]

FLAT PANEL DISPLAY WITH THIN FILM TRANSISTOR

[Brief Description of the Drawings]

FIG. 1 is a plane view of a structure of an active layer on a thin film transistor (TFT) in an active matrix type electroluminescence display device according to an embodiment of the present invention;

FIG. 2 is a plane view of crystallized structures of a first active layer of a switching TFT and a second active layer of a driving TFT;

FIG. 3 is a cross-sectional view of different thicknesses of the first active layer of the switching TFT and the second active layer of the driving TFT in line I-I direction in FIG. 2;

FIG. 4 is a graph of a relation between a size of a crystal grain and a current mobility;

FIG. 5 is a graph of a relation between an energy density and a size of a crystal grain in an excimer laser annealing (ELA) method;

FIG. 6 is a partially enlarged view of one sub-pixel in FIG. 1;

FIG. 7 is an equivalent circuit diagram of a unit pixel in FIG. 6;

FIG. 8 is a cross-sectional view in line II-II direction in FIG. 6; and

FIG. 9 is a cross-sectional view in line III-III direction in FIG. 6.

[Detailed Description of the Invention]

[Object of the Invention]

[Technical Field of the Invention and Related Art prior to the Invention]

The present invention relates to an active matrix type flat panel display including a thin film transistor (TFT), and more particularly, to a flat panel display including a TFT

having a polycrystalline silicon as an active layer, and channel areas of the active layers in a switching TFT and a driving TFT having different thickness and crystal grains of different sizes from each other.

A thin film transistor (TFT) in a flat display device such as a liquid display device, an organic electroluminescence display device, or an inorganic electroluminescence display device is used as a switching device for controlling operations of pixels and a driving device for driving the pixels.

The TFT includes a semiconductor active layer having a drain area and a source area doped with impurities of high concentration and a channel area formed between the drain area and the source area, a gate insulating layer formed on the semiconductor active layer, and a gate electrode formed on the gate insulating layer which is located on an upper part of the channel area of the active layer. The semiconductor active layer can be classified into an amorphous silicon and polycrystalline silicon according to crystallized status of the silicon.

The TFT using the amorphous silicon has an advantage in that a deposition can be performed at a low temperature, however, it also has disadvantages in that an electrical property and a reliability of the TFT are degraded and it is difficult to make the display device be a larger area. Thus, the polycrystalline silicon is mainly used recently. The polycrystalline silicon has a higher mobility of tens of - hundreds of $cm^2/V.s$, and low high frequency operation property and leakage current value, thereby it is suitable to be used in the flat panel display of high resolution and larger area.

On the other hand, TFT is used as the switching device or the driving device of the pixel in the flat panel display as described above. An organic electroluminescence display device of an active matrix type in an active driving method includes at least two TFTs per sub-pixel.

The organic electroluminescence device has an emission layer made of an organic material between an anode electrode and a cathode electrode. In the organic electroluminescence device, when a positive voltage and a negative voltage are respectively applied to the electrodes, holes injected from the anode electrode are

moved to the emission layer through a hole transport layer, and electrons are injected into the emission layer through an electron transport layer from the cathode electrode. The holes and electrons are recombined on the emission layer to produce exitons. The exitons are changed from an excited status to a ground status, and accordingly, phosphor molecules of emission layer are radiated to form an image. In case of a full-color electroluminescence display, pixels radiating red (R), green (G), and blue (B) colors are disposed as the electroluminescence devices to realize the full colors.

In the active matrix type organic electroluminescence display device, a panel with high resolution is required, however, the above described TFT formed using the polycrystalline silicon of high function causes some problems in this case.

That is, in the active matrix type flat panel display device such as the active matrix type organic electroluminescence display device, the switching TFT and the driving TFT are made of the polycrystalline silicon, thus, the two TFTs have the same current mobility. Therefore, switching properties of the switching TFT and low current driving properties of the driving TFT cannot be satisfied simultaneously. That is, in case where the driving TFT and the switching TFT of high resolution display device are fabricated using the polycrystalline silicon having larger current mobility, the high switching property of the switching TFT can be obtained, however, a brightness becomes too high since a current flowing toward an electroluminescence (EL) device through the driving TFT increases, thus increasing a current density per unit area and decreasing a life time of the EL device.

On the other hand, in case where the switching TFT and the driving TFT of the display device are fabricated using the amorphous silicon having the low current mobility, the TFTs should be fabricated in such way that the driving TFT uses a small current and the switching TFT uses a large current.

To solve the above problems, methods for restricting current flowing through the driving TFT are provided, such as a method for increasing resistance of a channel area by reducing a ratio of a length for a width of the driving TFT (W/L) and a method for

increasing resistance by forming a low doped area on the source/drain areas of the driving TFT.

However, in the method decreasing the W/L by increasing the length, a length of the channel area increases, thus forming stripes on the channel area and reducing an aperture area in a crystallization process in an excimer laser annealing (ELA) method. The method decreasing W/L by reducing the width is limited by a design rule of a photolithography process, and it is difficult to ensure a reliability of the TFT.

Also, the method for increasing the resistance by forming the low doped area requires an additional doping process.

[Technical Goal of the Invention]

The present invention provides a flat panel display in which an on-current of a driving thin film transistor (TFT) is lowered while keeping constant a driving voltage applied thereto, without changing a size of an active layer of the TFT.

The present invention also provides a flat panel display capable of maintaining high switching properties of a switching TFT, satisfying uniform brightness by a driving TFT, and maintaining a life span of a light emitting device.

[Structure and Operation of the Invention]

According to an aspect of the present invention, there is provided a flat panel display comprising: a light emitting device; a switching thin film transistor including a semiconductor active layer having at least a channel area for transferring a data signal to the light emitting device; and a driving thin film transistor including a semiconductor active layer having at least a channel area for driving the light emitting device so that a predetermined current flows through the light emitting device according to the data signal, the channel area of the thin film transistor requiring larger current mobility than the other between the switching thin film transistor and the driving thin film transistor being thinner than the channel area of the other thin film transistor.

The thickness of the channel area of the switching thin film transistor may be thinner than that of the channel area of the driving thin film transistor.

The thickness of the channel area of the thin film transistor requiring larger current mobility between the switching thin film transistor and the driving thin film transistor may be in a range of 300 – 800 Å, and the thickness of the thin film transistor requiring smaller current mobility between the switching thin film transistor and the driving thin film transistor may be in a range of 500 – 1500 Å.

The semiconductor active layer may be formed using the polycrystalline silicon, and the size of crystal grain on the channel area of the switching thin film transistor and the size of crystal grain on the channel area of the driving thin film transistor may be different from each other.

The size of crystal grain on the channel area of the switching thin film transistor may be larger than that of the crystal grain on the channel area of the driving thin film transistor.

The polycrystalline silicon may be formed in a crystallization method using a laser, and the channel area of the switching thin film transistor and the channel area of the driving thin film transistor may be formed simultaneously by irradiating the laser.

Preferred embodiments of the present invention will now be described with reference to the attached drawings.

FIG. 1 is a plane view of an active layer structure of a thin film transistor (TFT) in an active matrix type organic electroluminescence display according to an embodiment of the present invention. In FIG. 1, red (R), green (G), and blue (B) sub-pixels are repeatedly arranged in a longitudinal direction (up-and-down direction in FIG. 1) in a pixel of the organic electroluminescence display. However, the arrangement of the pixels is not limited to the above structure, and the sub-pixels of respective colors can be arranged in various patterns such as a mosaic pattern, or a grid type pattern to construct the pixel. Also, a mono color flat panel display can be used instead of a full-color flat panel display shown in FIG. 1.

In the organic electroluminescence display, a plurality of gate lines 51 are arranged in a transverse direction (left-and-right direction in FIG. 1), and a plurality of data lines 52 are arranged in a longitudinal direction. Also, driving lines 53 for supplying driving voltages (Vdd) are arranged in the longitudinal direction. The gate line 51, the data line 52, and the driving line 53 are disposed to surround one sub-pixel.

On the other hand, in above construction, each sub-pixel of the R, G, and B pixels includes at least two TFTs such as a switching TFT and a driving TFT. The switching TFT transfers a data signal to a light emitting device according to a signal of the gate line 51 to control operations of the light emitting device, and the driving TFT drives the light emitting device so that a predetermined current flows on the light emitting device according to the data signal. The number of TFTs and arrangement of TFTs such as the switching TFT and the driving TFT can be varied from properties of the display device and a driving method of the display device.

The switching TFT 10 and the driving TFT 20 respectively include a first active layer 11 and a second active layer 21, that is, semiconductor active layers, and the active layers 11 and 21 include channel areas (not shown) which will be described later. The channel areas are the areas located on center portions of the first active layer 11 and the second active layer 21 in a current flowing direction.

As shown in FIG. 1, in sub-pixels forming the R, G, and B pixels, the first active layer 11 included in the switching TFT 10 and the second active layer 21 included in the driving TFT 20 can be formed differently in thicknesses from each other. The first active layer 11 and the second active layer 21 can be formed commonly regardless of the R, G, and B pixels, however, a white balance can be maintained by differentiating a crystallized structure of the second active layer 21 forming the driving TFT 20, although this is not shown in drawings.

On the other hand, according to an embodiment of the present invention, the first active layer 11 and the second active layer 21 can be formed using a polycrystalline silicon thin film. The first active layer 11 and the second active layer 21 formed by the polycrystalline silicon thin film can be formed differently in thickness of the channel

areas. In the embodiment of the present invention, the active layer of the TFT which requires larger current mobility value than the other between the first active layer 11 and the second active layer 21 can be formed to have thinner channel area. Here, it is sufficient that the channel areas on center portions of the first active layer 11 and the second active layer 21 have different thickness, however, entire thicknesses of the first and second active layers may be different from each other due to the complexity in designing the above structure.

The changes in the thickness of the channel area of the TFT active layer causes a lot of changes in the TFT properties, when the thickness of the channel area on the active layer is thin, the current mobility increases on the channel area, and accordingly, excellent TFT properties can be obtained. Therefore, when the thickness of the channel area on the TFT active layer requiring higher current mobility value is formed to be thin, excellent TFT properties can be obtained. Accordingly, the thickness of the first active layer 11 on the switching TFT 10 is formed thinner than that of the second active layer 21 of the driving TFT 20. The excellent TFT properties can be achieved in the amorphous silicon, as well as the polycrystalline silicon.

On the other hand, sizes of the crystal grains can be differentiated when the amorphous silicon is crystallized into the polycrystalline silicon by forming the channel areas of the first active layer 11 of the switching TFT 10 and the second active layer 21 of the driving TFT 20 to have different thickness from that of each other. Accordingly, the current mobility can be differentiated. Also, an additional process for controlling the size of crystal grain is not required, and even if the laser is irradiated to two active layers simultaneously in the crystallization process by the ELA method, the active layers having different crystal grain sizes can be obtained.

Therefore, the sizes of the active layers, that is, plane areas of the active layers are same, and high resolution can be realized by reducing the current transferred from the driving TFT to the light emitting device.

In the organic electroluminescence display device, an on-current of the switching TFT should increase and the on-current of the driving TFT should decrease to form the

TFT suitable for the high resolution, especially for the high resolution of a small size. In the embodiment of the present invention, the different on-currents can be realized by forming the active layers of the respective TFTs to have different thickness from each other. That is, the on-current of the switching TFT is increased and the on-current of the driving TFT is decreased by controlling the thickness of the channel areas of the active layers on the TFTs.

The thickness of the channel area of the switching TFT active layer and the thickness of the channel area of the driving TFT active layer can be decided by the current mobilities on the channel areas. When the current mobility on the channel area of the active layer is large, the on-current is also large, and when the current mobility on the channel area is small, the on-current is also small. Consequently, in order to realize the high resolution by reducing the on-current of the driving TFT, the thickness of the channel areas of the active layers should be controlled so that the current mobility on the channel area of the driving TFT active layer is smaller than that on the channel area of the switching TFT active layer.

Therefore, as shown in FIG. 3, when the thickness (d1) of the first active layer 11 of the switching TFT is thinner than the thickness (d2) of the second active layer 21 of the driving TFT, the current mobility on the channel area of the switching TFT increases and the current mobility on the channel area of the driving TFT decreases relatively. The above operations can be performed on the active layer formed using the amorphous silicon. Also, the entire thickness of the first and second active layers 11 and 21 are controlled in FIG. 3, however, only the thickness of the channel area can be controlled.

On the other hand, controlling the thickness of the channel area on the respective active layer affects the size of the crystal grain according to the crystallization of the silicon thin film. That is, energy density applied to the amorphous silicon is differentiated from the thickness of the silicon thin film when the amorphous silicon is crystallized by the laser, and accordingly, the size of the crystal grain of the

polycrystalline silicon thin film is differentiated. The size of the crystal grain differentiates the current mobility of the channel area.

FIG. 2 is a view of the first active layer of the switching TFT and the second active layer 21 of the driving TFT adopting different crystallization structures of polycrystalline silicon thin films. The polycrystalline silicon thin film is formed by crystallizing the amorphous silicon thin film in an excimer laser annealing (ELA) method. Previously described FIG. 3 is a cross-sectional view in line I-I direction of FIG. 2.

As shown in FIG. 4, the larger the size of crystal grain is, the larger the current mobility is, thus forming a nearly straight line.

Therefore, in the embodiment of the present invention shown in FIG. 2, the size of crystal grain on the channel area of the switching TFT active layer, which requires larger current mobility, is larger than that on the channel area of the driving TFT active layer, which requires smaller current mobility, and consequently, the on-current value of the driving TFT can be lowered.

That is, as shown in FIG. 2, the first active layer 11 of the switching TFT is formed on a first crystallization structure 61 having larger crystal grain, and the second active layer 21 of the driving TFT is formed on a second crystallization structure 62 having smaller crystal grain. The crystallization structures on the channel areas of the respective active layers can be differentiated from each other, of course.

The difference in the crystal grain size can be obtained by differentiating the thickness of the active layers from each other as shown in FIG. 3. That is, the thickness d1 of the silicon thin film having the first crystallization structure 61, on which the first active layer 11 of the switching TFT is formed, is formed thinner than the thickness d2 of the silicon thin film having the second crystallization structure 62 on which the second active layer 21 of the driving TFT is formed.

When the thickness of the silicon thin film becomes thinner, the energy density applied to the amorphous silicon becomes higher, and larger crystal grain can be obtained by a relation shown in FIG. 5. FIG. 5 is a view of a difference between the sizes of crystal grains according to the energy densities of the irradiating laser, in the

crystallization process of the amorphous silicon thin film of 500Å in the ELA method. When the amorphous silicon thin film receives the laser of excessively high energy density, the silicon thin film may be melted completely and the size of the crystal grain may become smaller. Therefore, it is preferable that the silicon thin film of the first crystallization structure 61 on which the first active layer 11 of the switching TFT requiring larger crystal grain will be formed is not excessively thin.

Therefore, it is preferable that the thickness d1 of the silicon thin film on which the first active layer 11 of the switching TFT will be formed is in a range of 300 – 800Å, and the thickness d2 of the silicon thin film on which the second active layer 21 of the driving TFT will be formed is in a range of 500 – 1500Å. A photolithography process is performed to differentiate the thicknesses of the silicon thin films. In the photolithography method, the thickness of the patterned amorphous silicon thin film is controlled by controlling light transmittance of an optical mask for the area on which the first active layer of the switching TFT will be formed and for the area on which the second active layer of the driving TFT will be formed.

The thickness d1 of the silicon thin film on which the first active layer 11 of the switching TFT will be formed is formed thinner than the thickness d2 of the silicon thin film on which the second active layer 21 of the driving TFT will be formed, thus increasing the size of crystal grain so that the current mobility on the channel area of the first active layer 11 of the switching TFT is larger than the current mobility on the channel area of the second active layer 21 of the driving TFT. Consequently, the on-current of the driving TFT can be lowered, thus realizing the high resolution. Also, according to the present invention, the sizes of crystal grain can be differentiated from each other with one laser irradiation using the thickness difference, thereby, the processes of fabricating TFT can be simplified.

On the other hand, the sub-pixel of the organic electroluminescence display device having the switching TFT and the driving TFT has a structure shown in FIGS. 6 through 9.

FIG. 6 is a partially enlarged plane view of a sub-pixel among the sub-pixels in FIG. 1, and FIG. 7 is a view of an equivalent circuit of the sub-pixel shown in FIG. 6.

Referring to FIG. 7, the respective sub-pixel of the active matrix type organic electroluminescence display according to an embodiment of the present invention includes two TFTs such as a switching TFT 10 for switching and a driving TFT 20 for driving, a capacitor 30, and an electroluminescence (EL) device 40. The number of TFTs and the number of capacitors are not limited thereto, more TFTs and capacitors can be included according to a design of a desired device.

The switching TFT 10 is operated by a scan signal which is applied to the gate line 51 to transfer a data signal which is applied to the data line 52. The driving TFT 20 decides a current flowing into the EL device 40 according to the data signal transferred through the switching TFT 10, that is, voltage difference between a gate and a source. The capacitor 30 stores the data signal transferred through the switching TFT 10 for one frame unit.

The organic electroluminescence display devices having the structure shown in FIGS. 6, 8, and 9 are formed to realize the above circuit. As shown in FIGS. 6, 8, and 9, a buffer layer 2 is formed on an insulating substrate 1 made of glass, and the switching TFT 10, the driving TFT 20, the capacitor 30, and the EL device 40 are disposed on the buffer layer 2.

The switching TFT 10 includes a gate electrode 13 connected to the gate line 51 for applying TFT on/off signals, a source electrode 14 formed on the gate electrode 13 and connected to the data line 52 for supplying the data signal to the first active layer, and a drain electrode 15 connecting the switching TFT 10 with the capacitor 30 to supply power source to the capacitor 30. A gate insulating layer 3 is disposed between the first active layer 11 and the gate electrode 13.

The capacitor 30 for charging is located between the switching TFT 10 and the driving TFT 20 for storing a driving voltage required to drive the driving TFT 20 for one frame unit, and may include a first electrode 31 connected to the drain electrode 15 of the switching TFT 10, a second electrode 32 formed to overlap with the first electrode

31 on an upper part of the first electrode 31 and connected to a driving line 53 through which the power source is applied, and an interlayer dielectric layer 4 formed between the first electrode 31 and the second electrode 32 to be used as a dielectric substance, as shown in FIGS. 6 and 8. The structure of the capacitor 30 is not limited to the above, for example, a silicon thin film of TFT and the gate electrode can be used as the first electrode and the second electrode, and a gate insulating layer may be used as the dielectric layer, also various methods can be used.

As shown in FIGS. 6 and 9, the driving TFT 20 includes a gate electrode 23 connected to the first electrode 31 of the capacitor 30 for supplying TFT on/off signals, a source electrode 24 formed on an upper part of the gate electrode 23 and connected to the driving line 53 for supplying a reference common voltage to the second active layer 21, and a drain electrode 25 connecting the driving TFT 20 with the EL device 40 for applying a driving voltage to the EL device 40. A gate insulating layer 3 is disposed between the second active layer 21 and the gate electrode 23. Here, the channel area of the active layer 21 of the driving TFT 20 has a different crystallization structure from that of the channel area of the first active layer 11 of the switching TFT 10, that is, a different size in the crystal grain.

As shown in FIGS. 8 and 9, the thickness d1 of the first active layer 11 of the switching TFT is formed thinner than the thickness d2 of the second active layer 21 of the driving TFT, thereby, the size of crystal grain of the first active layer 11 is formed to be larger than that of the crystal grain of the second active layer 21 by irradiating the laser for one time in the ELA method.

On the other hand, the EL device 40 displays a predetermined image information by emitting lights of red, green, and blue colors according to flows of the current. As shown in FIGS. 6 and 9, the EL device 40 includes an anode electrode 41 connected to the drain electrode 25 of the driving TFT 20 for receiving positive power source from the drain electrode 25, a cathode electrode 43 disposed to cover the entire pixel for supplying negative power source, and an organic emission layer 42 disposed between the anode electrode 41 and the cathode electrode 43 for emitting lights. Unexplained

reference numeral 5 denotes an insulating passivation layer made of SiO_2, and reference numeral 6 denotes an insulating planarized layer made of acryl, or polyimide.

The above layered structure of the organic electroluminescence display according to the embodiment of the present invention is not limited thereto, and the present invention can be applied to any different structures from the above.

The organic electroluminescence display having the above structure according to the embodiment of the present invention is fabricated as follows.

As shown in FIGS. 8 and 9, a buffer layer 2 is formed on an insulating substrate1 of glass material. The buffer layer 2 can be formed using SiO_2 and can be deposited in a plasma enhanced chemical vapor deposition (PECVD) method, an atmospheric pressure chemical vapor deposition (APCVD) method, a low pressure chemical vapor deposition (LPCVD) method, or an electron cyclotron resonance (ECR) method. Also, the buffer layer 2 can be deposited to have a thickness about 3000 Å.

An amorphous silicon thin film is deposited on an upper part of the buffer layer 2, and the photolithography process is performed on the silicon thin film so that the thickness d1 of the area on which the first active layer 11 of the switching TFT 10 will be formed is in a range of 300 – 800 Å, and the thickness d2 of the area on which the second active layer 21 of the driving TFT 20 will be formed is in a range of 500 – 1500 Å. The difference in the thickness can be generated with one exposure process by differentiating the light transmittances of the optical masks. That is, after applying a photoresist on the areas on which the first active layer11 of the switching TFT 10 and the second active layer 21 of the driving TFT 20 will be formed, the photoresist is exposed using masks having different light transmittances from each other, developed, and etched.

The amorphous silicon thin film formed as described above can be crystallized into the polycrystalline silicon thin film in various ways. Here, energy densities applied to the area on which the second active layer 21 of the driving TFT 20 will be formed and to the area on which the first active layer 11 of the switching TFT 10 will be formed are

different from each other, thus, increasing the size of crystal grain on the area of the first active layer.

The first active layer 11 of the switching TFT 10 and the second active layer 21 of the driving TFT 20 are patterned as shown in FIG. 1 after making the different crystallization structures. The patterning process of the active layers may be performed simultaneously with the process of generating thickness difference on the amorphous silicon thin film, or performed after depositing the gate insulating layer, and the gate electrode.

After performing the patterning process of the active layers, the gate insulating layer is deposited on the patterned layers in PECVD, APCVD, LPCVD, or ECR method, and a conductive layer is formed using MoW, or Al/Cu and patterned to form the gate electrode. The active layer, the gate insulating layer, and the gate electrode may be patterned in various orders and methods.

After patterning the active layer, the gate insulating layer, and the gate electrode, N-type or P-type impurities are doped on the source and drain areas. As shown in FIGS. 8 and 9, after completing the doping process, an interlayer dielectric layer 4 is formed, the source electrodes 14 and 24 and the drain electrodes 15 and 25 are connected to the active layers 11 and 21 through contact holes, and a passivation layer 5 is formed. The layers may adopt various structures according to design of the device.

On the other hand, the EL device 40 connected to the driving TFT 20 can be formed in various ways, for example, an anode electrode 41 connecting to the drain electrode 25 of the driving TFT 20 may be formed and patterned on the passivation layer 5 using an indium tin oxide (ITO), and a planarized layer 6 may be formed on the anode electrode 41.

In addition, after exposing the anode electrode 41 by patterning the planarized layer 6, an organic layer 42 is formed thereon. Here, the organic layer 42 may use a low molecular organic layer or a high molecular organic layer. In case where the low molecular organic layer is used, a hole injection layer, a hole transfer layer, an organic

emission layer, an electron transfer layer, and an electron injection layer may be formed by being stacked in a single or a combination structure. Also, various organic materials such as copper phthalocyanine (CuPc), N,N-Di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB), and tris-8-hydroxyquinoline aluminum (Alq3) can be used. The low molecular organic layer is formed in a vacuum evaporation method.

The high molecular organic layer may include the hole transfer layer and an emission layer. Here, the hole transfer layer is formed using poly(3,4-ethylenedioxythiophene (PEDOT), and the emission layer is formed using a high molecular organic material such as poly-phenylenevinylene (PPV)-based material or polyfluorene-based material in a screen printing method or in an inkjet printing method.

After forming the organic layer, the cathode electrode 43 is entirely deposited using Al/Ca, or patterned. An upper part of the cathode electrode 43 is sealed by a glass or a metal cap. Here, the cathode electrode 43 may be formed as a transparent electrode in case where the organic electroluminescence display device is a front light emtting type.

In above descriptions, the present invention is applied to the organic electroluminescence display device, however, the scope of the present invention is not limited thereto. The TFT according to the present invention can be applied to any display devices such as a liquid crystal display (LCD), and inorganic electroluminescence display devices .

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

[Effect of the Invention]

According to the present invention, a current transferred from the driving TFT to the light emitting device can be reduced without changing the size of the active layer in TFT or the driving voltage, and accordingly, a structure suitable for realizing the high resolution can be obtained. A switching TFT having excellent switching properties can be obtained, and at the same time, a driving TFT by which the high resolution can be realized can be obtained using properties of the polycrystalline silicon. Also, excellent response characteristics and the high resolution can be realized only by controlling the thickness of active layer. In addition, a structure having crystal grains of different sizes can be obtained with one irradiation of the laser by generating a difference in the thickness of the amorphous silicon thin film, and accordingly, the current mobility values on the channel areas of the switching TFT and the driving TFT can be different from each other. The crystallization structure of TFT according to the present invention is capable of maintaining uniform brightness and preventing life time of the display from degrading. The aperture area is not reduced since there is no need to increase the length (L) of the driving TFT. Also, a reliability of TFT can be improved since there is no need to reduce the width (W) of the driving TFT.

What is claimed is:

1. A flat panel display comprising:

a light emitting device;

a switching thin film transistor including a semiconductor active layer having at least a channel area for transferring a data signal to the light emitting device; and

a driving thin film transistor including a semiconductor active layer having at least a channel area for driving the light emitting device so that a predetermined current flows through the light emitting device according to the data signal,

wherein the channel area of the thin film transistor requiring larger current mobility than the other between the switching thin film transistor and the driving thin film transistor being thinner than the channel area of the other thin film transistor.

2. The flat panel display of claim 1, wherein the thickness of the channel area of the switching thin film transistor is thinner than that of the channel area of the driving thin film transistor.

3. The flat panel display of claim 1, wherein the thickness of the channel area of the thin film transistor requiring larger current mobility between the switching thin film transistor and the driving thin film transistor is in a range of 300 – 800 Å, and the thickness of the thin film transistor requiring smaller current mobility between the switching thin film transistor and the driving thin film transistor is in a range of 500 – 1500 Å.

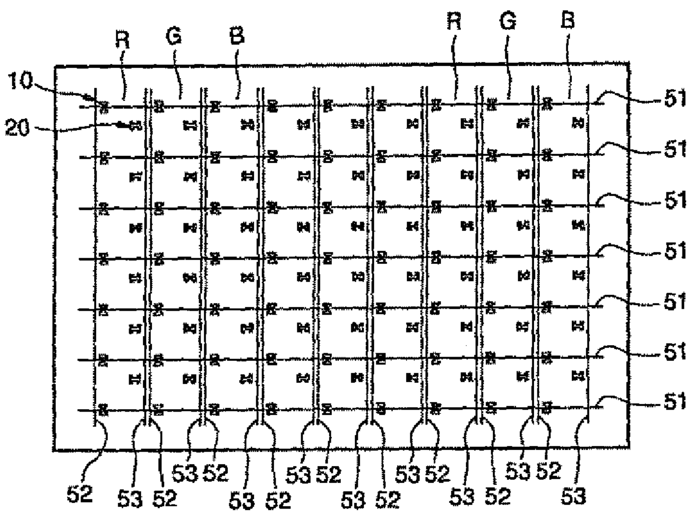
4. The flat panel display of any one of claims 1-3, wherein the semiconductor active layer is formed using the polycrystalline silicon, and the size of crystal grain on the channel area of the switching thin film transistor and the size of crystal grain on the channel area of the driving thin film transistor are different from each other.

5. The flat panel display of claim 4, wherein the size of crystal grain on the channel area of the switching thin film transistor is larger than that of the crystal grain on the channel area of the driving thin film transistor.

6. The flat panel display of claim 4, wherein the polycrystalline silicon is formed in a crystallization method using a laser.

7. The flat panel display of claim 6, wherein the channel area of the switching thin film transistor and the channel area of the driving thin film transistor are formed simultaneously by irradiating the laser.

FIG. 1


R
G
B
R
G
B
10
20
51
51
51
51
51
51
51
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52
53
52
53
52
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53

FIG. 2

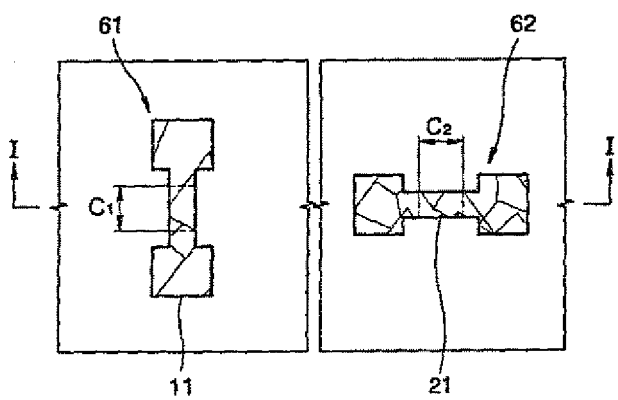

61
62
I
I
C1
C2
11
21

FIG. 3

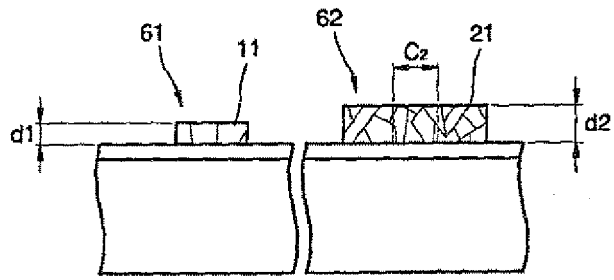

61
11
62
C2
21
d1
d2

FIG. 4

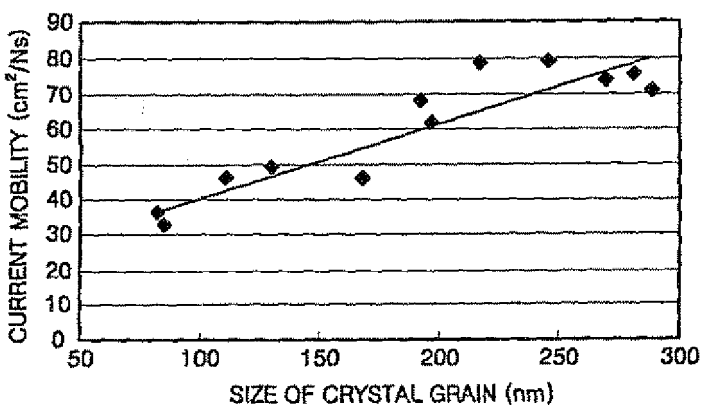
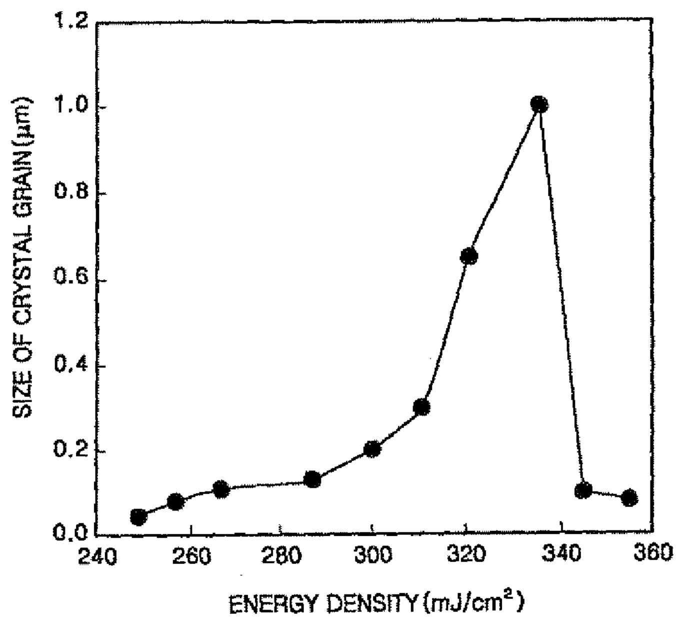

CURRENT MOBILITY (cm²/Ns)
90
80
70
60
50
40
30
20
10
0
50
100
150
200
250
300
SIZE OF CRYSTAL GRAIN (nm)

FIG. 5



SIZE OF CRYSTAL GRAIN (μm)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
240
260
280
300
320
340
360
ENERGY DENSITY (mJ/cm²)

FIG. 6

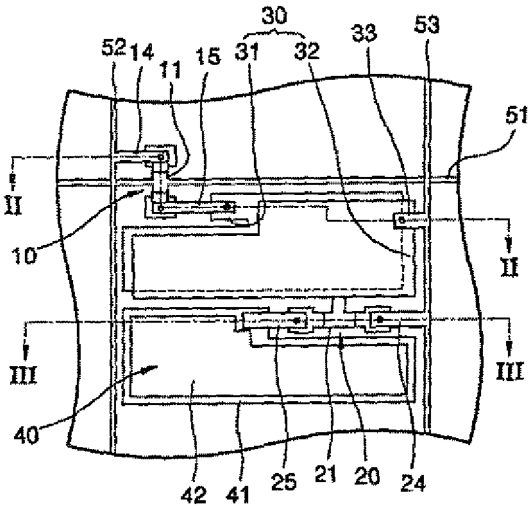

30
52
14
11
15
31
32
33
53
51
II
II
10
III
III
40
42
41
25
21
20
24

FIG. 7

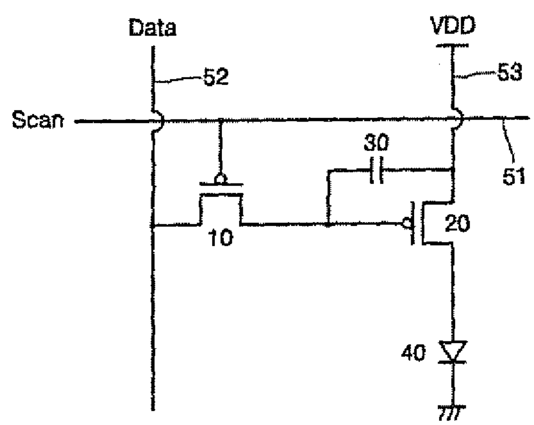

Data
VDD
52
53
Scan
30
51
20
10
40

FIG. 8

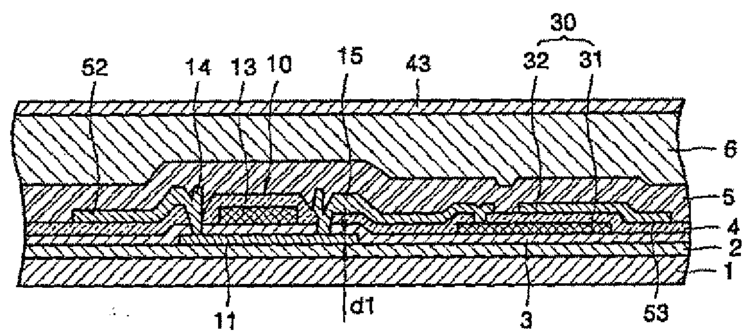
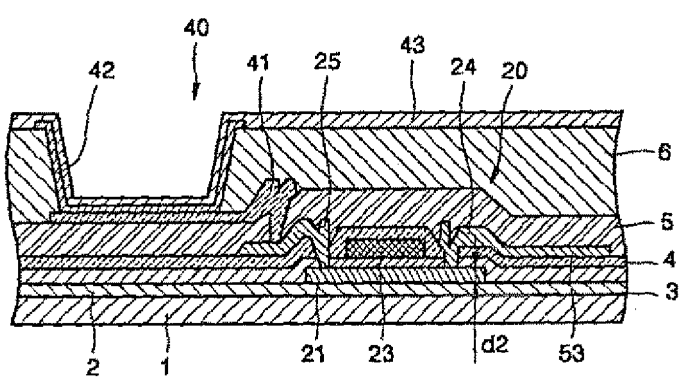

30
52
14
13
10
15
43
32
31
6
5
4
2
1
11
d1
3
53

FIG. 9


40
42
41
25
43
24
20
6
5
4
3
2
1
21
23
d2
53